



Advance Development of Breakthrough and Piezoelectric-Based Systems

(Scoping of Electric Program Investment Charge (EPIC) Solicitation)

Prab Sethi

Energy Generation Research Office
Energy Research and Development Division

California Energy Commission
Rosenfeld Hearing Room, Sacramento
September 14, 2015



Housekeeping

- Facilities
- Emergency Exit
- Sign-In Sheet



Outline

- Workshop Purpose
- Solicitation Purpose
- Solicitation Information
- Breakthrough/Disruptive Technologies
- Piezoelectric-Based Systems
- Public Input
- Additional Comments



Workshop Purpose

1. Receive public input to identify preferred technology areas to fund applied research and development activities to advance breakthrough energy generation technologies and piezoelectric-based systems.
2. Develop scope for the proposed solicitation to dramatically increase system efficiencies, reduce costs, and enable additional renewable resources.
3. Highlight opportunities for moving forward under the Electric Program Investment Charge (EPIC)
4. Encourage broad participation in the solicitation process

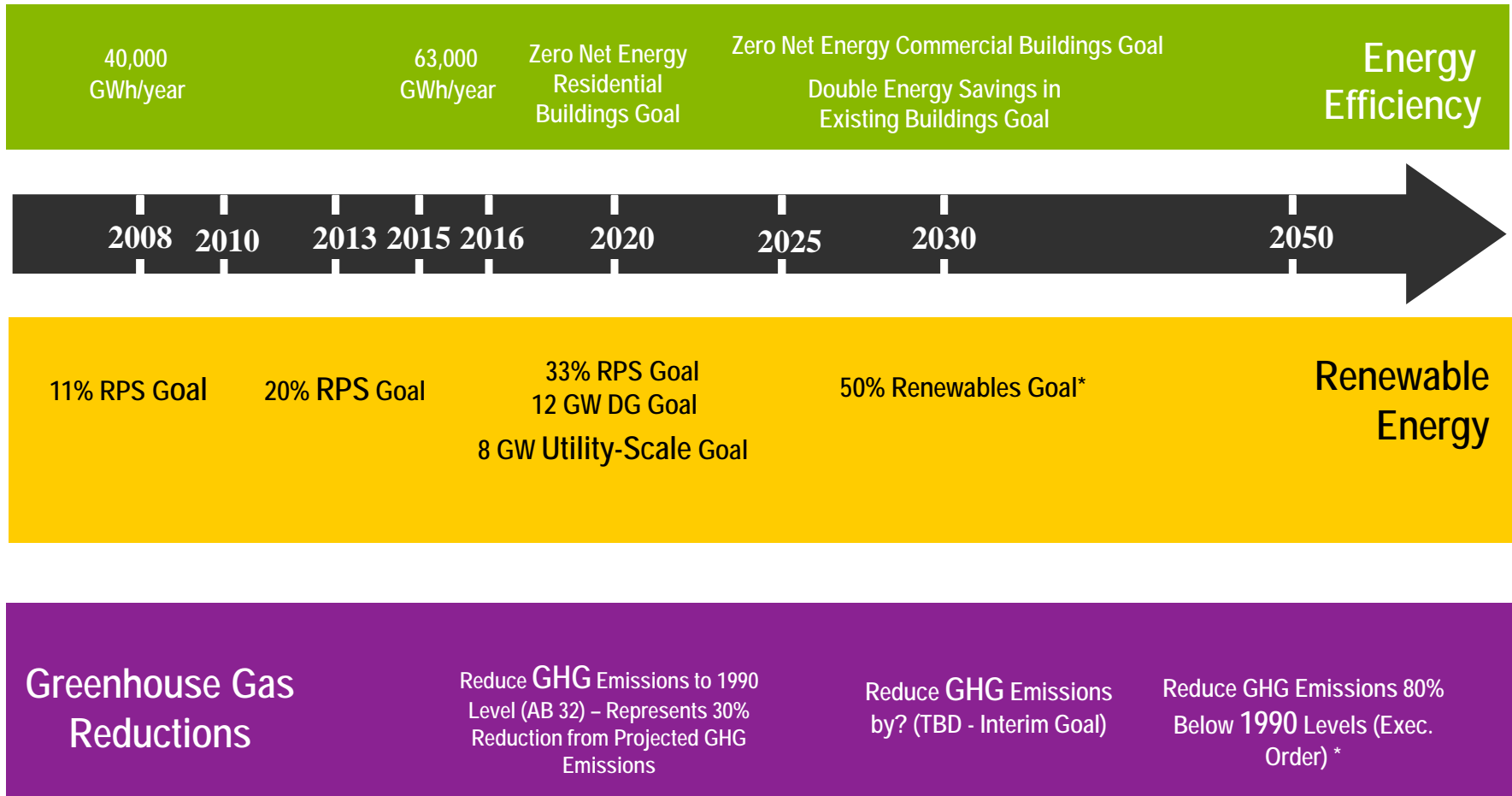


Renewable Energy Policy Goals

- **Governor Brown's Clean Energy Jobs Plan**, which calls for 12,000 MW of renewable distributed generation by 2020 and 6500 MW of additional CHP capacity by 2030.
- **Senate Bill X1 2**, which orders the Renewable Portfolio Standard (RPS) to be increased to 33 percent by 2020, and
- **Assembly Bill 32** (Global Warming Solutions Act), which sets the maximum allowable level of statewide greenhouse gas emissions in 2020 at the level of emissions in 1990



State Energy Policy Drivers



* Pending



Electric Program Investment Charge (EPIC)

- Established by CPUC in 2012 to fund investments to advance clean energy technologies and approaches for the benefit of investor-owned utility electricity ratepayers.
- The Energy Commission administers approximately \$130 million per year.
- EPIC uses an **energy innovation pipeline** approach to creating new energy solutions, fostering regional innovation, and bringing clean energy ideas to the marketplace





Solicitation Purpose

- Fund applied research and development activities to advance breakthroughs in renewable energy technologies to dramatically increase efficiencies, reduce costs, and enable additional renewable resources.
- Fund development of piezoelectric-based systems for harvesting energy to maximize efficient use of emerging energy sources in California.
- Awards will support development, lab-scale, and pilot-scale demonstrations of pre-commercial technologies and strategies that are designed to solve specific problems in the electric generation sector.



Solicitation Background

- Solicitation developed to address applied research and development activities under Energy Commission's 2015-2017 Investment Plan for the Electric Program Investment Charge
- Strategic Initiatives:
 - S3.4 Advance Breakthroughs in Renewable Energy Technologies to Dramatically Increase Efficiencies Reduce Costs, and Enable Additional Renewable Resources
 - S3.5 Develop Piezoelectric-Based Systems for Harvesting Energy to Maximize Efficient Use of Emerging Energy Sources in California.



Solicitation Information

- 2-Phase Solicitation
- Solicitation Amount: \$7 million
- Required Match Funding: \$0 (Match funding will get preferential scoring)
- Expected Release Date: Jan – Mar 2016

Project Group	Estimated Award Amount	Estimated Total Funding Amount	Estimated Number of Awards
Group 1: Breakthrough Technologies	\$750,000	\$3,000,000	4
Group 2: Piezoelectric-Based Systems	\$2,000,000	\$4,000,000	2



1. Breakthrough/Disruptive Technologies





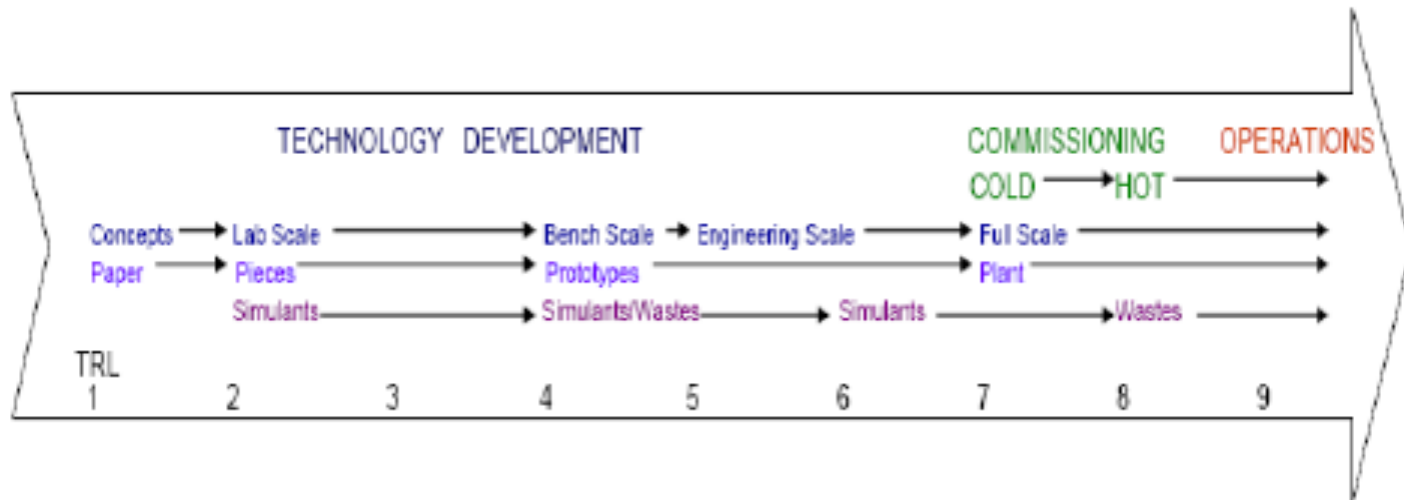
Breakthrough Technologies

- Develop early-stage innovative electricity generation technologies and novel applications with breakthrough potential in the commercial market.
- Target technology advancements that will dramatically increase energy conversion efficiencies, reduce system costs, and expand the use of potential renewable resources that are not currently utilized for electricity generation.
- Develop novel systems and technologies to address issues on efficiency, affordability, reliability, and durability that will enable accelerated integration and deployment of renewable-based distributed generation technologies.



Minimum Eligibility Criteria

- Proposed breakthrough technology or process must result in net generation of electricity.
- Technology readiness level from TRL2 to TRL5¹ for breakthroughs (laboratory to < pilot scale demonstration)



¹Technology Readiness Level, Department of Energy
<http://www2.lbl.gov/dir/assets/docs/TRL%20guide.pdf>



Minimum Eligibility Criteria (Cont.)

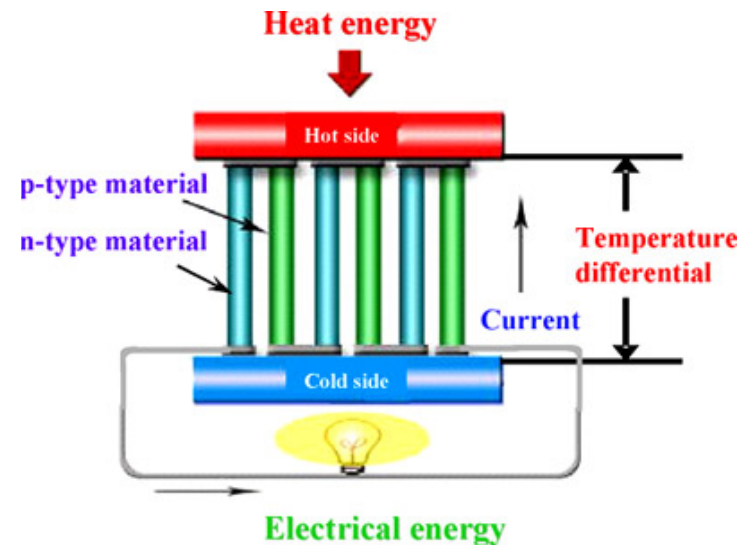
- Market potential must be equal to or greater than 100 times the initial investment.
- Must meet or exceed the latest California Air Resource Board and local air district emissions standards.
- Must have a credible purpose and a projected competitive advantage over existing commercial technology



Possible Breakthrough Technologies

- Thermoelectric Power Generation from Waste Heat
- Thermoacoustic engines for converting heat into useful energy by using high-pressure sound waves
- Advanced Solar Cell Printing
- Nanogeneration Energy-harvesting Technologies
- Biomimicry Applications - Designing Nature Inspired Technologies
- Others – Not Listed

Thermoelectric Power Generation (from Waste Heat)



Phone Charging by Boiling Water

By using the Seebeck effect, enough electricity can be produced to charge a cell phone and other USB devices



Thermo Acoustic Engine

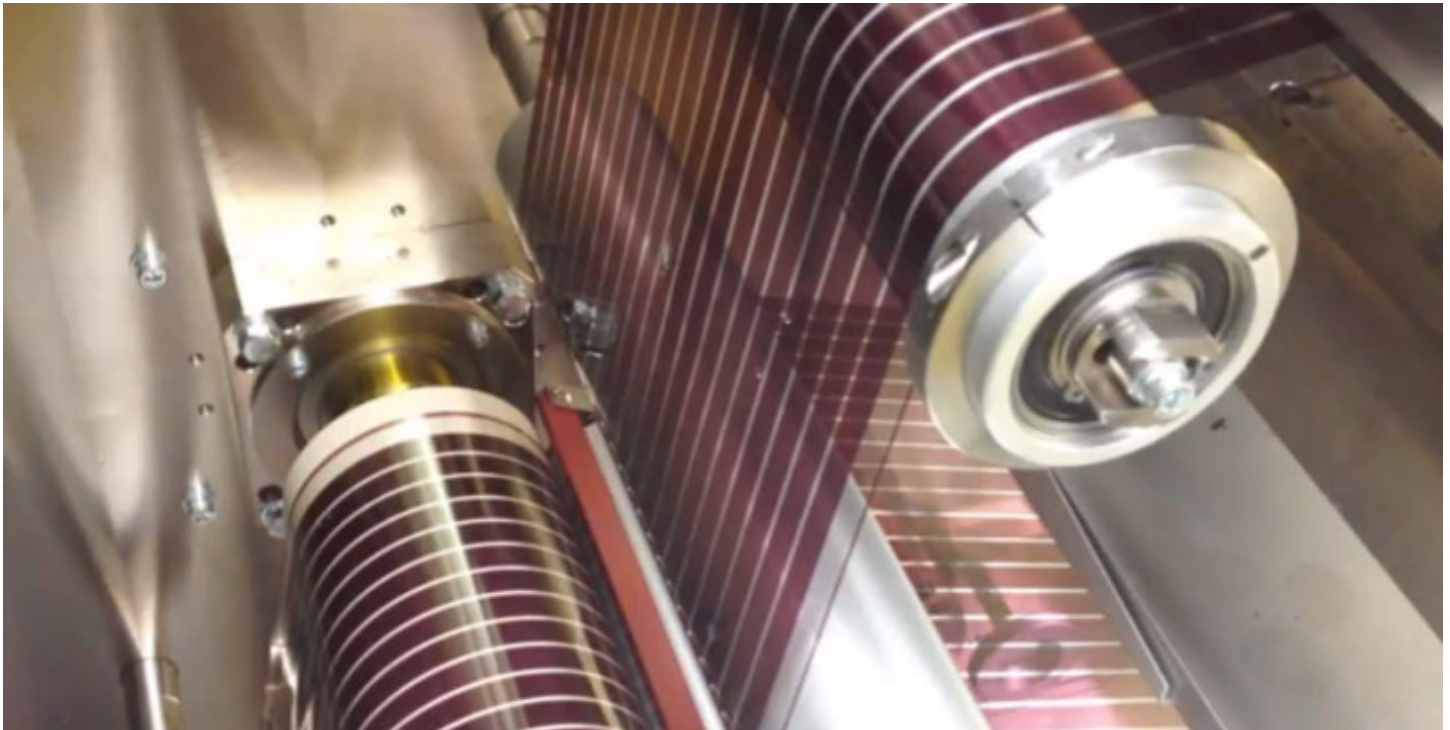
(Converting Heat into Useful Energy by Using High-Pressure Sound Waves)



Source: <http://gyroscope.com/youtube.asp?movie=TiG5CANfOPA>



Printed Solar Cells



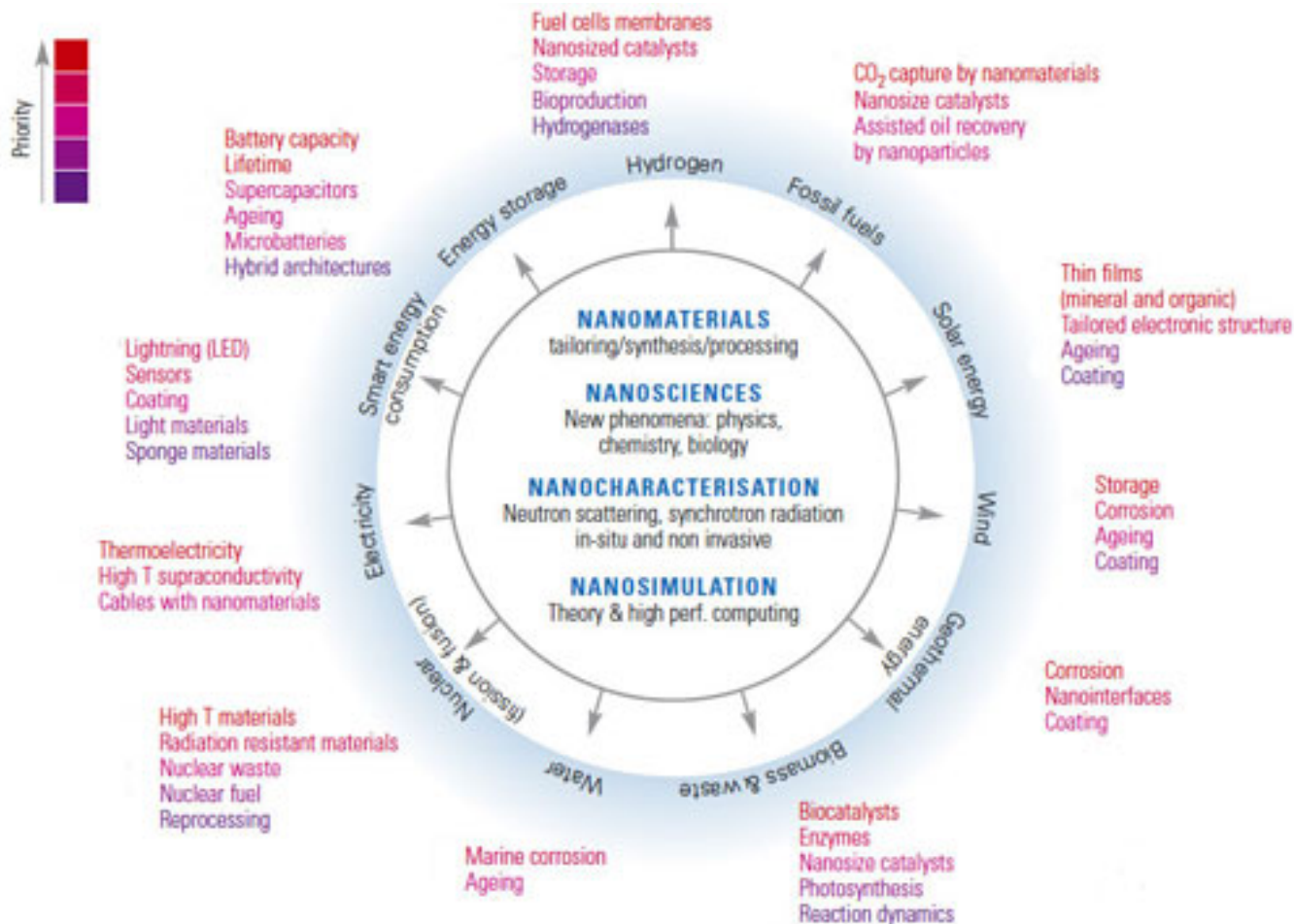
(Needs to be part of an applied research and development system)



Nanogeneration Energy Harvesting Technologies

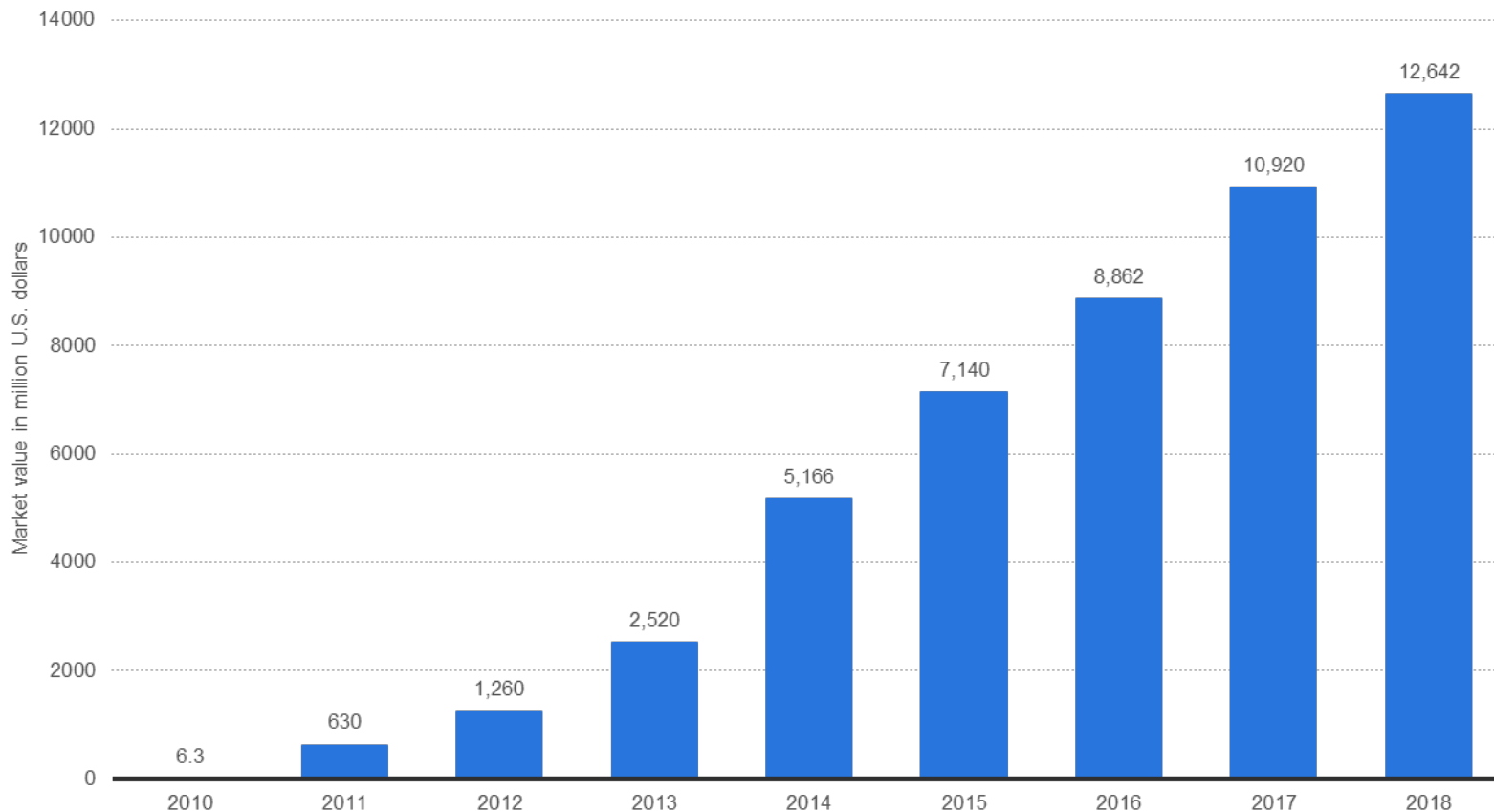
- Nanotechnology is the understanding and control of matter at dimensions between approximately 1 and 100 nanometers, where unique phenomena enable novel applications
- Technologies to enable devices to power themselves based on ambient electromagnetic, thermal, or mechanical energy.

Application of Nanomaterials





Wearable device market value from 2010 to 2018 (in million U.S. dollars)



Note: Worldwide

Source: Business Insider;



Biomimicry

- Biomimicry - the practice of designing technologies that are inspired by nature.
 - Redesigning wind turbine blades based on avian wings.

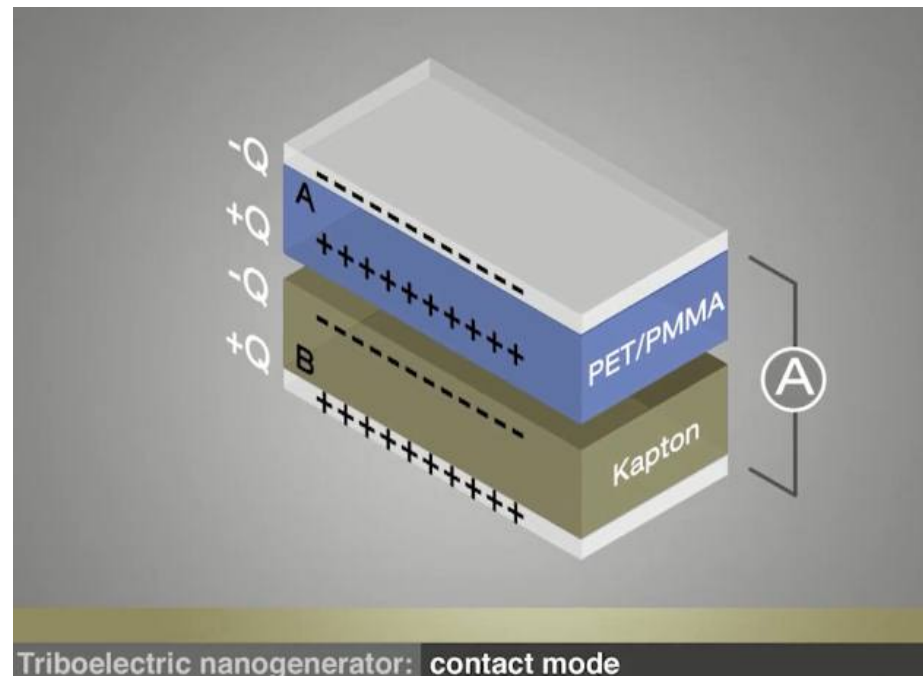




Ineligible Technologies

- Basic Research to discover fundamental knowledge or identification of new materials
- Concentrating PV, hybrid PV/thermal technologies
- Concentrating Solar Thermal Power
- Biomass conversion and biogas generation technologies
- Ocean energy and tidal power technologies
- Biofuel production technologies

2. Piezoelectric Effect



Miniature Generator based on piezoelectric effect,
which is electricity resulting from pressure.



Piezoelectric-based Systems for Energy Harvesting

- Piezoelectric materials generate electricity with the application of stress or vibration compared to the photovoltaic semiconductor, which generates electricity with the application of light



Goals for Piezoelectric Systems

- Advance electricity generation technologies by application of piezoelectric materials and utilizing wasted mechanical energy
- Assessment of piezoelectric system applications to determine technical and economic feasibilities, projected power output, costs, and marketing potentials
- Evaluate technology to quantify performance, durability, lifetime, and integration of energy storage to address expected intermittency during power generation.
- Pilot scale projects to harvest power from existing roadway surfaces, train tracks, or sidewalk applications to cost-effectively increase renewable energy capacity



Potential for Piezoelectric Systems

Potential generation per km for a roadway Piezoelectric system

LCOE	\$0.11/kWh
Capital Cost	\$9,615/kW
Capacity Factor	0.09
Vehicle Flow Rate (vehicles/hr)	611
Power Per Unit (W)	143
Unit Spacing (in)	8
Nameplate Power Density (W/ft ²)	322
Nameplate Power System Rating (kW/km)	1,408
Actual System Output (kW/km)	107

Source: DNV Kema,

<http://www.energy.ca.gov/2013publications/CEC-500-2013-007/CEC-500-2013-007.pdf>



Target Technical Specifications for Piezoelectric Systems

- LCOE less than or equal to \$0.10/kWh
- Power density great than or equal to 300 W/sq ft
- Lifetime greater than or equal to 15 years.



Commitment to Diversity

The Energy Commission adopted a resolution strengthening its commitment to diversity in our funding programs. We continue to encourage disadvantaged and underrepresented businesses and communities to engage in and benefit from our many programs. To meet this commitment, Energy Commission staff conducts outreach efforts and activities to:

- Engage with disadvantaged and underrepresented groups throughout the state.
- Notify potential new applicants about the Energy Commission's funding opportunities.
- Assist applicants in understanding how to apply for funding from the Energy Commission's programs.
- Survey participants to measure progress in diversity outreach efforts.



Administrative Requirements

- Demonstration sites must be located in California IOU service territory
- Additional scoring points awarded incrementally for spending greater than 60 percent to 100% EPIC funding in California



Needed Public Input

- Are requirements proposed for the “Minimum Eligibility Criteria” appropriate? Do we need to add any additional restrictions?
- How can we narrow down technologies under Breakthrough Project Group? Are there any technologies which should not be funded under this solicitation and why?



Needed Public Input (Cont.)

- Which innovative/disruptive technologies or applications should be funded under Breakthrough Strategic initiative and why?
- What kind of Piezoelectric applications should be funded?
- What are the appropriate metrics of success for Breakthrough and Piezoelectric-Based systems (cost of generation, renewable capacity deployed, market potential, etc.)?



Needed Public Input (Cont.)

- Any suggestions on how to better design this solicitation?
What is the minimum timeframe for assembling teams/proposals, permitting, and CEQA compliance?
- What strategies the Energy Commission can use to help facilitate proposals from a more diverse applicant pool, including disadvantaged communities?



Comments

Any additional comments must be submitted by
September 18



Availability of Workshop Documents and Information

- Documents and presentations for this meeting will be available online at <http://www.energy.ca.gov/research/notices/index.html/>
- Interested parties may also sign on to the Energy Commission electronic mailing list to ensure they are notified of future solicitations.



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Hosted by the California Energy Commission

<http://www.energy.ca.gov/listservers/>

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Anticipated 2015 EPIC Solicitations

Solicitation Title	Program Area/Strategic Objective	Estimated Funding Amount
Conduct Energy Research Gap Assessment and Roadmapping	Applied Research and Development (S10)	\$3 million
Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts: Phase II	Applied Research and Development (S5)	\$8.5 million
Clean Energy Research, Technology Showcase, and Policy Forums	Market Facilitation (S18)	\$1 million
Measuring Innovation Progress to Guide Future Investment	Market Facilitation (S18)	\$1 million
Establish Strategies for Enhanced Local Regulatory Assistance and Permit Streamlining that will Accelerate Deployment of Clean Energy	Market Facilitation (S16)	\$17.3 million
Developing Technologies, Tools, and Strategies to Enable the Smart Grid of 2020	Applied Research and Development (S6)	\$8 million
Guiding Future Energy Needs, Plans, and Programs through Commercial End-Use Surveys	Market Facilitation (S18)	\$8 million
Reducing Costs for Communities and Business Through Integrated Demand-Side Management and Zero-Net Energy Demonstrations	Applied Research and Development (S1)	\$3 million
	Technology Demonstration and Deployment (S12 & S14)	\$20 million
Developing New Technologies and Applications that Enable cost-beneficial Customer-Side -of-the-Meter Energy Choices	Applied Research and Development (S2)	\$16.4 million
Developing a Portfolio of Advanced Efficiency Solutions (Phase 2)	Applied Research and Development (S1)	\$7 million
Developing Operational Tools, Models, and Simulations to Improve Grid Resource Planning	Applied Research and Development (S7)	\$TBD

This list is updated periodically online at: <http://energy.ca.gov/contracts/epic.html>



Closing Comments

- Workshop Participation Survey?



Thanks for Participating!

Please e-mail comments to

Prab Sethi at
prab.sethi@energy.ca.gov

Please use e-mail Subject Heading:
“COMMENTS: Breakthrough and Piezoelectric Workshop”

Deadline for comments: Friday, September 18, 2015